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## (54) Reproduction apparatus and reproduction method

(57) This invention provides a reproduction apparatus and a reproduction method for reproducing data from a recording medium comprising a program area provided in advance with absolute addresses and a controlled area storing the absolute start address of each program recorded on it in correspondence to the program number thereof.

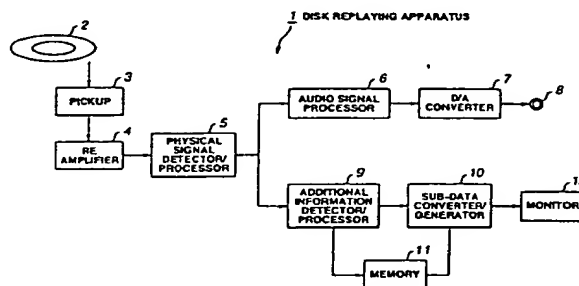


FIG.1

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a memory means for storing the start address of each program contained in the controlled area of the second recording medium operated by said reproduction means for data reproduction and expressed in terms of absolute address in correspondence to the program number of the program;

5 a comparison means for comparing the absolute address reproduced from said program area of said second recording medium by said reproduction means with the start address of each program stored in said memory means in correspondence to the program number of the program; and

10 a display control means for displaying, upon selection of said first recording medium, the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction on the basis of the program numbers stored collaterally in said program area and, upon selection of said second recording medium, the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction on the basis of the result of comparison of said comparison means.

15 [0009] According to a third aspect of the invention, there is provided a reproduction apparatus adapted to selectively reproduce data from a first layer having a program area collaterally storing program numbers and the passed-by addresses of each program in addition to information on the programs stored on it and a controlled area for controlling the start address of each of the programs expressed in terms of absolute address in correspondence to the program number of the program or a second layer having a program area storing a plurality of programs provided with absolute addresses and a controlled area for controlling the start address of each program expressed in terms of absolute address in correspondence to the program number thereof, said apparatus comprising:

a reproduction means for reproducing data from the controlled area and the program area of said selected layer;

25 a memory means for storing the start address of each program contained in the controlled area of the second layer operated by said reproduction means for data reproduction and expressed in terms of absolute address in correspondence to the program number of the program;

a comparison means for comparing the absolute address reproduced from said program area of said second layer by said reproduction means with the start address of each program stored in said memory means in correspondence to the program number of the program; and

30 a display control means for displaying, upon selection of said first layer, the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction on the basis of the program numbers stored collaterally in said program area and, upon selection of said second layer, the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction on the basis of the result of comparison of said comparison means.

35 [0010] Thus, according to the invention, the additional information including the track numbers and the elapsed time on each track will be detected from the disk being replayed that stores digital audio signals in a format different from that of a CD and subsequently converted into channel status data and user data equivalent to those of a CD as defined for the CD at the digital audio interface so that auxiliary information including the numbers of the pieces recorded on the disk and the elapsed time on each track may be displayed.

40 [0011] The hereinafter described embodiment of the present invention can provide a reproduction apparatus and a reproduction method that can transform and generate channel status data and user data in a format equivalent to that of CDs and display auxiliary data such as address number and the elapsed time of each piece of music when reproducing data from a disk storing digital audio signals in a format different from that of CDs.

45 [0012] Now, preferred embodiments of reproduction apparatus and reproduction methods according to the present invention will be described by way of non-limitative example with reference to the accompanying drawings in which:

[0013] FIG. 1 is a schematic block diagram of a disk replaying apparatus embodied according to the invention.

[0014] FIG. 2 is a schematic illustration of the data structure of a sub-coding frame format applicable to known CDs.

[0015] FIG. 3 is a schematic illustration of the frame data structure of a Q data applicable to known CDs.

50 [0016] FIG. 4 is a schematic illustration of the frame data structure of a Q data in a program area applicable to known CDs.

[0017] FIG. 5 is a schematic illustration of the data structure of a sub-frame conforming to the Digital Audio Interface Standards.

[0018] FIG. 6 is a schematic illustration of the data structure of a frame conforming to the Digital Audio Interface Standards.

55 [0019] FIG. 7 is a schematic illustration of the data structure of channel status data.

[0020] FIG. 8 is a schematic illustration of the data structure of user data when the category of channel status data indicates the CD category.

[0021] FIG. 9 is a schematic illustration of the data structure when a sub-frame conforming to the Digital Audio

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address (ADR) bits indicating the data mode, 72 Q data bits and 16 cyclic redundancy check (CRC) bits for the generation of parity check codes. The number of address (ADR) bits will be reduced to 1 when the data in the program area are being reproduced.

[0046] FIG. 4 is a schematic illustration of the frame data structure of a Q data including only an address (ADR) bit. It includes track no TNO, index number X, the elapsed time on the track (minute (MIN), second (SEC), frame (FRAME)), the absolute time (minute (AMIN), second (ASEC), frame (AFRAME)) from the head of the disk and CRC. Note that the elapsed time on the track is that of a track with a specific track number.

[0047] FIG. 5 is a schematic illustration of the data format of a sub-frame conforming to the Digital Audio Interface Standards (IEC 958 Standards). FIG. 6 is a schematic illustration of the data structure of a frame containing sub-frames as shown in FIG. 6, physical signal detector/processor 5 and conforming to the Digital Audio Interface Standards (IEC 958 Standards). A block is formed by 192 frames, each comprising two sub-frames.

[0048] The sync preamble, user data (U bit), channel status data (C bit) and other data exist in each frame in addition to audio data for the left and right channels.

[0049] FIG. 7 is a schematic illustration of the data format of channel status data. The data contains a category code for identifying the type of apparatus, the sampling frequency fs and CONTROL bits for indicating the presence or absence of emphasis.

[0050] FIG. 8 is a schematic illustration of the data format of a user data when the category code of FIG. 7 is "10000000", indicating that the signal source is a CD reproduction apparatus. Here, codes Q through W are listed to exclude P code and, particularly, the 96 bits Q code will be extracted therefrom.

[0051] FIG. 9 and FIG. 10 show examples of data including user data (U) and channel status data (C) that can be actually output along with audio data.

[0052] Thus, as described above, a digital output of a CD player contains channel status data indicating the CD category and user data indicating the track number and the elapsed time of the track.

[0053] On the other hand, according to the above described newly established standards for optical disks, a start address that corresponds to the absolute time of the start of a track in the audio area is written in Track\_List\_2 in the area TOC data. Only the time code contained in the initial header of each audio sector that corresponds to the absolute time of the start can be read out during an ordinary operation of reproducing data from a track.

[0054] FIG. 11A is a schematic illustration of the data structure of the audio area on an optical disk conforming to the Standards, where each of the two area TOCs arranged on the opposite sides of the track area has a configuration as shown in FIG. 11B. Track\_Start\_Time\_Code of each track is described in Track\_List\_2 in the area TOC as shown in the syntax of FIG. 12. Index start time code Index\_Start\_TC of each index number as shown in the syntax of FIG. 13 is described in Index\_List of FIG. 11B.

[0055] On the other hand, Audio Sector as shown in FIG. 11D is provided on each track as shown in FIG. 11C in the track area of FIG. 11A and Frame\_Info as shown in the syntax of FIG. 14 is described in Audio Header in the Audio Sector. More specifically, Time\_Code of each frame is described there as shown in FIG. 15.

[0056] As described above, according to the HD standards, only the time code (absolute time) of each frame can be read out from a track area that is a program area during an ordinary operation of reproducing data from a track unlike the CD format. In other words, information such as track numbers and the elapsed time of each track is not recorded. Therefore, it is not possible to display track numbers and the elapsed time of each track.

[0057] In order to overcome this inconvenience, the disk replaying apparatus 1 firstly reads out area TOC (Table of Contents) data and stores it in memory 8 as shown in FIG. 1 when a disk is placed in position. Thus, the memory 8 stores a table of TRACK LIST 2 and INDEX LIST as shown in FIG. 16.

[0058] For driving the optical disk 2 for data reproduction and adding user data U bit) to its digital output, Q data as shown in FIG. 17 has to be produced by additional information detector/processor 9 through a data conversion/generation process.

[0059] Now, a conversion processing operation of a sub-data will be described by referring to FIG. 18. Firstly, the time code (absolute time) of the audio header has to be read out as TCP for each frame while the optical disk 2 is driven for data reproduction. Then, in Step S1, the absolute time TCA (minute M, second S, frame F) of the TCP is written as shown in FIG. 17.

[0060] Then, in Step S2, Track\_Start\_Time\_Code (TC2) of Track No. 2 (TNO. 2) is compared with the above TCP. If TCP is smaller than TC2, the operation proceeds to Step S3, where the current track number is specified as TNO. 1. In Step S4, TC1 of Track Number 1 (TNO. 1) is subtracted from the TCP to produce elapsed time TCN (minute, second, frame).

[0061] After Step S4, the operation proceeds to the processing sequence of \*1 surrounded by broken lines in FIG. 18, where the index number (IDX) in the track number TNO. 1 is determined.

[0062] In Step S5, Index\_Start\_TC of INDEX 2 of the track number TNO. 1 in Index\_List is compared with the above TCP. If the above TCP is smaller than Index\_Start\_TC of INDEX 2, the operation proceeds to Step S6, where the index number is determined to be equal to "1". If, on the other hand, it is found in Step S5 that the above TCP is greater than Index\_Start\_TC of INDEX 2, the operation proceeds to Step S7, where Index\_Start\_TC of INDEX 3 of the track number TNO. 1 is compared with the above TCP. If the above TCP is smaller than Index\_Start\_TC of INDEX 3, the operation proceeds to Step S8, where the index number is determined to be equal to "2". If, on the other hand, it is found in Step S7 that the above TCP is greater than Index\_Start\_TC of INDEX 3, the operation proceeds to Step S9, where Index\_Start\_TC of INDEXM of the track number TNO. 1 is compared with the above TCP. If the above TCP is smaller than Index\_Start\_TC of INDEXM, the operation proceeds to Step S10, where the index number is determined to

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channel status data and user data equivalent to those of a CD so that the auxiliary information recorded on the disk such as the numbers of the pieces and the elapsed time on each track can be displayed.

[0079] While the above described disk replaying apparatus 1 is adapted to reproduce data from a CD or an HD, the present invention may also be applied to an apparatus adapted to replay a hybrid disk comprising a CD signal area and a 1-bit digital signal area arranged to show a multilayer configuration. In either case, the numbers of pieces and the elapsed time on each track relating to the audio signal reproduced from the CD layer or the 1-bit digital signal layer can be displayed on the monitor 12.

### Claims

1. A reproduction apparatus adapted to reproduce data from a recording medium comprising a program area provided with absolute addresses and a controlled area storing the absolute start address of each of the programs stored on it in correspondence to the program number thereof, said apparatus comprising:

a reproduction means for reproducing data from the controlled area and the program area of said recording medium;

a memory means for storing the start address of each program contained in the controlled area operated by said reproduction means for data reproduction and expressed in terms of absolute address in correspondence to the program number of the program;

a comparison means for comparing the absolute address reproduced from said program area by said reproduction means with the start address of each program stored in said memory means in correspondence to the program number of the program; and

a selection means for selecting the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction.

2. A reproduction apparatus according to claim 1, further comprising a display means for displaying the program number selected by said selection means.

3. A reproduction apparatus according to claim 1 or 2, wherein the controlled area of said recording medium further storing index numbers for dividing a single program into a plurality of parts and start addresses expressed in terms of absolute addresses corresponding to said index numbers;

said apparatus further comprising:

a second memory means for storing the start addresses expressed in terms of absolute addresses corresponding to said index numbers used to divide single program contained in said controlled area and reproduced by said reproduction means;

a second comparison means for comparing the absolute address reproduced from said program area by said reproduction means with the start address stored in said second memory means in correspondence to the related index number; and

a second selection means for selecting the index number corresponding to the position on said program area being replayed by said reproduction means on the basis of the result of comparison of said second comparison means.

4. A reproduction apparatus according to claim 3, further comprising a display means for displaying the index number selected by said second selection means.

5. A reproduction apparatus according to any one of the preceding claims, wherein the data to be stored in said program area are sigma-delta modulated 1-bit digital signals.

6. A reproduction apparatus according to any one of the preceding claims, further comprising an arithmetic means for computationally determining the elapsed time of the program being reproduced by said reproduction means on the basis of the absolute address reproduced from said program area by said reproduction means and the start address of the program corresponding to the program number stored in said memory means; and

a display means for displaying the elapsed time of the program as computationally determined by said arithmetic means.

7. A reproduction apparatus adapted to selectively reproduce data from a first recording medium having a program area collaterally storing program numbers and the passed-by addresses of each program in addition to information on the programs stored on it and a controlled area for controlling the start address of each of the programs

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controlling the start address of each program expressed in terms of absolute address in correspondence to the program number thereof, said apparatus comprising:

5 a reproduction means for reproducing data from the controlled area and the program area of said selected layer;

a memory means for storing the start address of each program contained in the controlled area of the second layer operated by said reproduction means for data reproduction and expressed in terms of absolute address in correspondence to the program number of the program;

10 a comparison means for comparing the absolute address reproduced from said program area of said second layer by said reproduction means with the start address of each program stored in said memory means in correspondence to the program number of the program; and

15 a display control means for displaying, upon selection of said first layer, the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction on the basis of the program numbers stored collaterally in said program area and, upon selection of said second layer, the program number corresponding to the position on said program area being operated by said reproduction means for data reproduction on the basis of the result of comparison of said comparison means.

- 20 14. A reproduction method for reproducing data from a recording medium comprising a program area provided with absolute addresses and a controlled area storing the absolute start address of each of the programs stored on it in correspondence to the program number thereof, said method comprising steps of:

replaying the controlled area of said recording medium;

25 storing the start address expressed in terms of absolute address of each program contained in the controlled area being reproduced in correspondence to the program number;

replaying said program area;

30 comparing the absolute address reproduced from said program area with the start address of each program corresponding to the program number stored in said memory; and

displaying the program number corresponding to the program being reproduced on the basis of the result of comparison in the above comparing step.

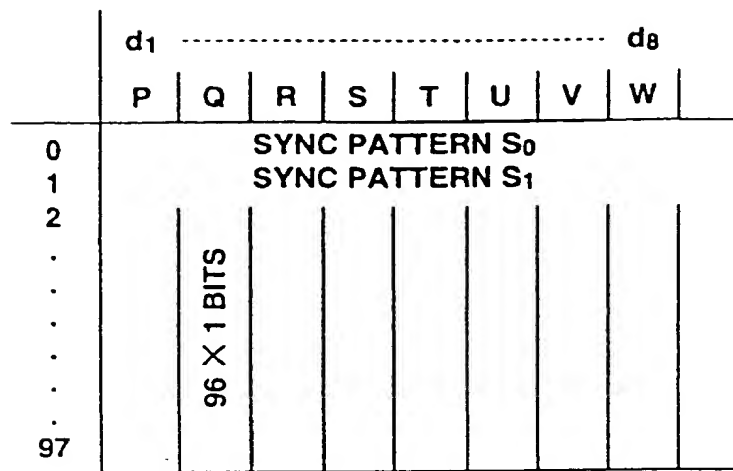


FIG.2

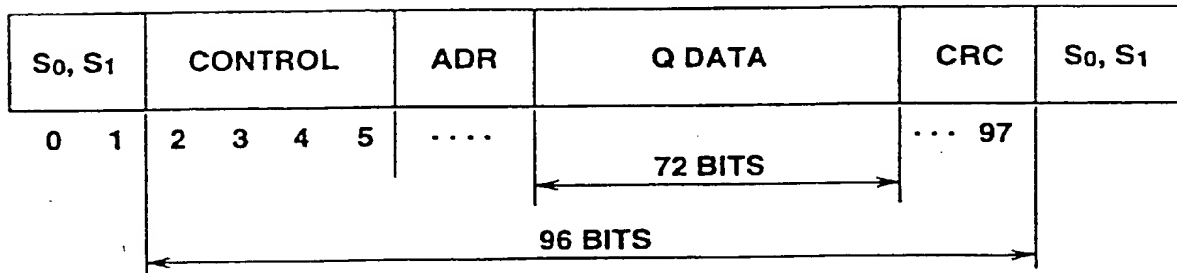


FIG.3

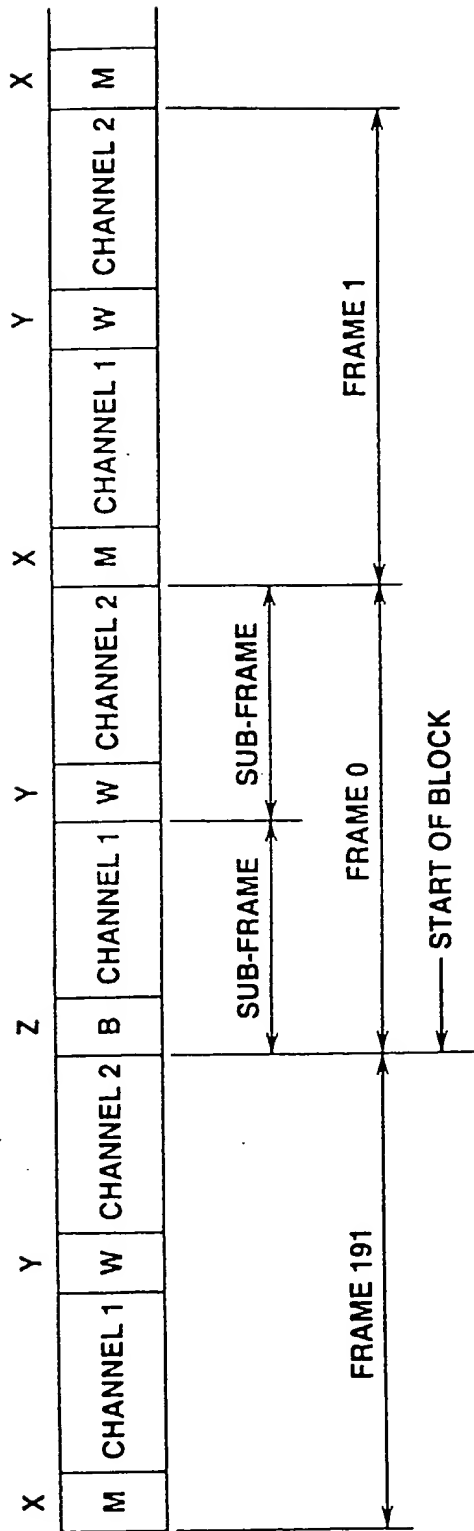


FIG.6

	0	1	2	3	4	5	6	7	8	9	10	11
0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
24	1	Q1	R1	S1	T1	U1	V1	W1	0	0	0	0
36	1	Q2	R2	S2	T2	U2	V2	W2	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.
1164	1	Q96	R96	S96	T96	U96	V96	W96	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
24	1	Q1	R1	S1	T1	U1	V1	W1	1	Q2	R2	T2
36	T2	U2	V2	W2	0	0	0	0	0	0	0	0
48	1	Q3	R3	S3	T3	U3	V3	W3	0	0	0	0
60	0	0	0	0	1	Q4	R4	S4	T4	U4	V4	W4
72	1	Q5	R5	S5	T5	U5	V5	W5	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.

FIG.8



No.	PREAMBLE SYNC	AUX	AUDIO SAMPLES				M S B	V	U	C	P
25	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	1	C13L	P
26	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	Q1	C13R	P
27	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	R1	C14L	P
28	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	S1	C14R	P
29	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	T1	C15L	P
30	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	U1	C15R	P
31	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	V1	C16L	P
32	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	W1	C16R	P
33	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C17L	P
34	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C17R	P
35	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C18L	P
36	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C18R	P
37	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	1	C19L	P
38	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	Q2	C19R	P
39	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	R2	C20L	P
40	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	S2	C20R	P
41	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	T2	C21L	P
42	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	U2	C21R	P
43	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	V2	C22L	P
44	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	W2	C22R	P
45	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C23L	P
46	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C23R	P
47	M	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C24L	P
48	W	0000	0000	XXXX	XXXX	XXXX	XXXX	0	0	C24R	P

FIG.10

	#bytes	format	value
Track_List_2(.) {			
Track_List_2 Signature	8	string	"SACDTRL2"
for (ton=1;ton<=N_Tracks;ton++)			
{	3	Time_Code	
Track_Start_Time_Code [ton]	1	UInt8	0
reserved			
}	Until 1028	UInt8	0
Reserved			
for (ton=1;ton<=N_Tracks;ton++)			
{	3	Time_Code	
Track_Time_Length [ton]	1	Track_Flags	
Track_Flags [ton]	Until 2048	UInt8	0
}			
Reserved			
}			

FIG.12

<pre> Audio_Header ( ) {     N_Packs     N_Frame_Starts     Reserved     for (p=1;p&lt;=N_Packets;p++)         Packet_Info ( ) [p]     for (f=1;f&lt;=N_Frame_Starts;f++)         Frame_Info ( ) [f] } </pre>			
#bytes	format	value	
3	UInt3	1..7	
3	UInt3	1..7	
2		0	
16	Packet_Info		
48	Frame/Info		

FIG.14

AREA TOC						
TRACK LIST2			INDEX LIST			
TRACK START TIME CODE	TN01	0M10S00F (TC <sub>1</sub> )	INDEX 2	2M10S00F	INDEX START TIME CODE	
			INDEX 3	3M10S00F		
			.	.		
	TN02	5M30S00F (TC <sub>2</sub> )	INDEX M	4M10S00F		
			INDEX 2	6M10S00F		
			INDEX 3	8M10S00F		
	TN03	10M20S00F (TC <sub>3</sub> )	.	.	.	.
			.	.	.	.
			.	.	.	.
	TN0N	(TC <sub>N</sub> )	INDEX 2	12M30S00F		
			.	.		
	TN0N	(TC <sub>N</sub> )	.	.	.	.
			.	.	.	.

FIG.16

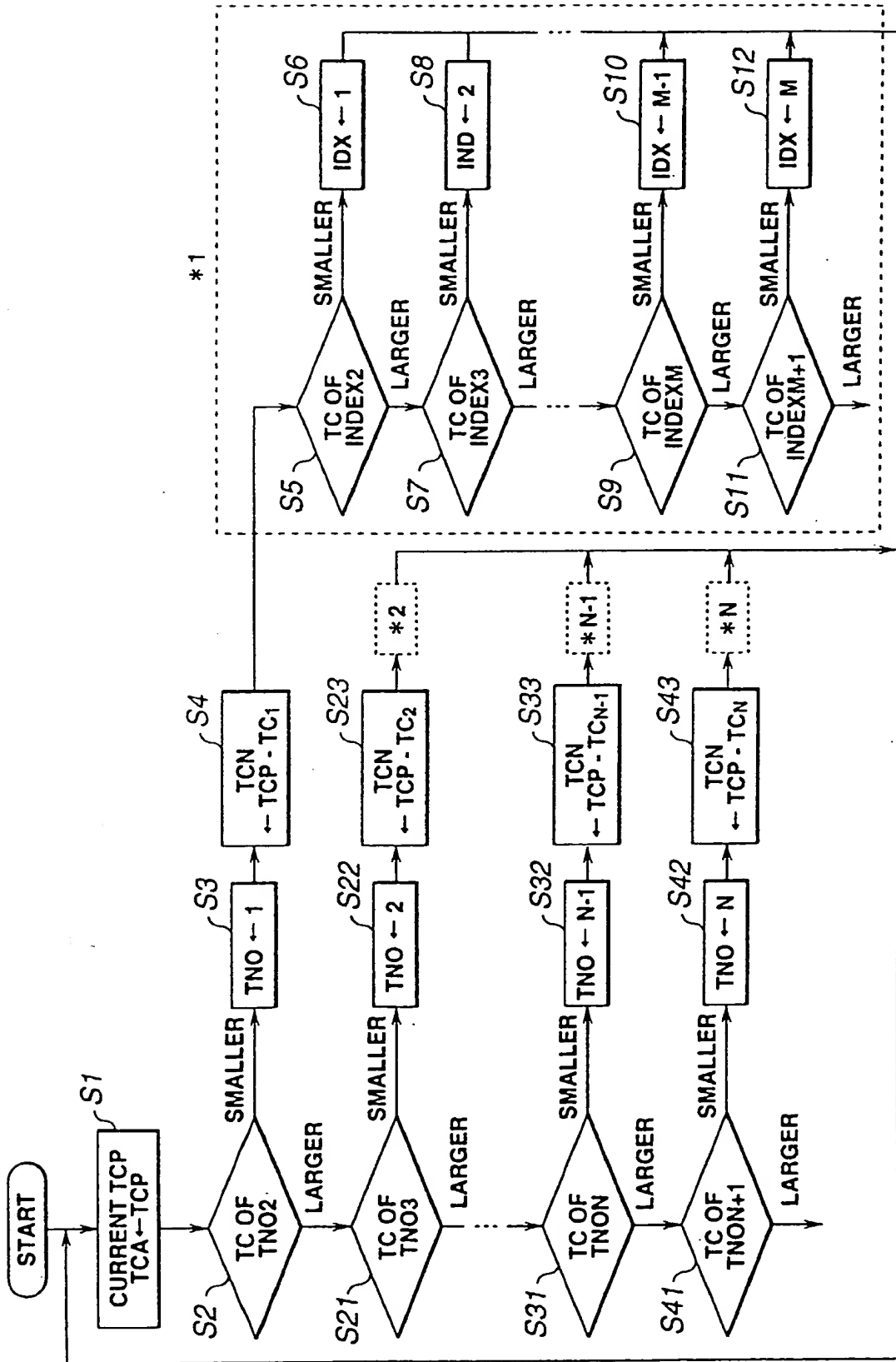


FIG.18